(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 893 929 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.01.1999 Bulletin 1999/04

(51) Int. Cl.[6]: **H04Q 7/34**, H04Q 7/30

(21) Application number: **98106060.1**

(22) Date of filing: **02.04.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **23.07.1997 JP 212601/97**

(71) Applicant:
Oki Electric Industry Co., Ltd.
Tokyo (JP)

(72) Inventor: **Nakajima, Keiichi**
7-12, Toranomon 1-chome, Minato-ku Tokyo (JP)

(74) Representative:
Grosse, Wolfgang, Dipl.-Ing.
Patentanwälte
Herrmann-Trentepohl
Grosse - Bockhorni & Partner,
Forstenrieder Allee 59
81476 München (DE)

(54) Digital mobile communication system

(57) The base station 6 incorporates the line supervisor 8, the line switch 9, and the signal returner 10. If there is originated a call request signal for the mobile station 3 by the mobile station 2 after occurrence of a break in the line between the base station 6 and the control station 21, the line supervisor 8 notifies the line switch 9 of the line switch signal. In response to the line switch signal, the line switch 9 actuates the signal returner 10. Thereafter, the signal returner 10 returns the call request signal over the base station zone of the base station 6. This enables communication among the mobile stations 2 and 3 laid in the base station zone of the base station 6.

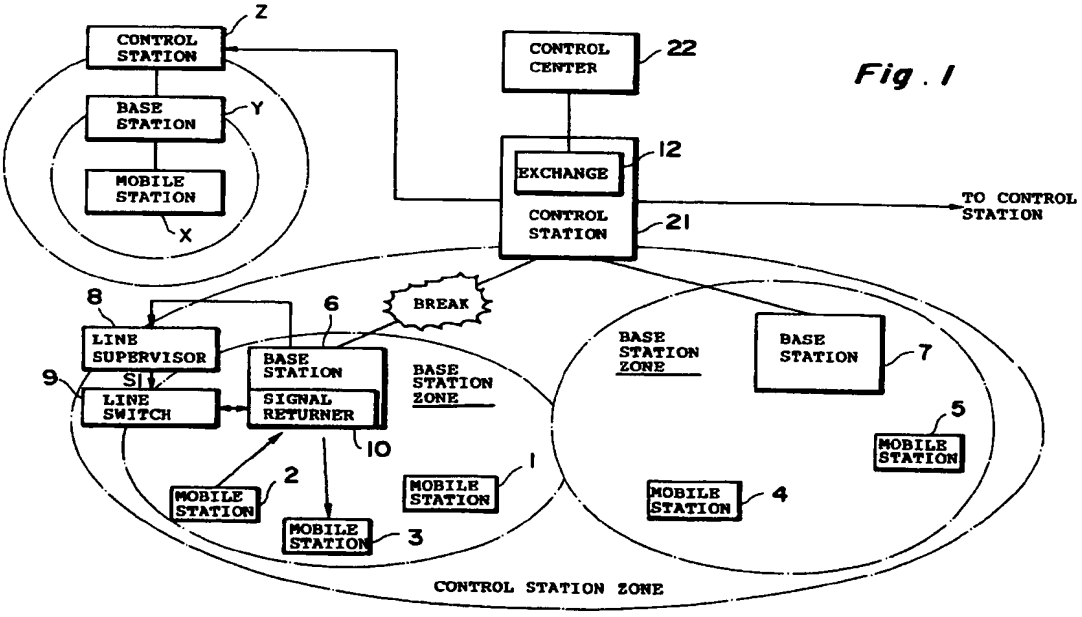


Fig. 1

EP 0 893 929 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a digital mobile communication system which is used for a public business digital mobile communication and the like.

2. Description of the Prior Art

Recently, information communication technologies have rapidly developed. In particular, the mobile communication technology in radio communication field has remarkably rapidly developed as well as the optical communication technology in the wire communication field.

The mobile communication is commonly categorized into a commercial communication and a non-commercial communication. Among the former communication, there are typically laid a cordless telephone, a portable telephone. Among the latter communication, there are typically laid a taxi radio communication, MCA (Multi-Channel Access) land mobile radio communication system, and a public business digital mobile communication system.

If there arises a disaster, the public business digital mobile communication system considerably serves for transmission of information on the disaster, in contrast with the other communication systems or networks which might malfunction. Accordingly, the disaster communication which is mainly performed by a base station and mobile stations communicating therewith, is essential.

Incidentally, in a conventional mobile communication system, e.g., the public business digital mobile communication system, the communication among the mobile stations requires the base station. More specifically, the mobile stations always communicate with each other via the base station. A plurality of base stations are arranged at a given distance laid thereamong. Each base station has a base station zone to control communication therein. Those base stations are controlled by a control station.

Communication between a mobile station and another mobile station requires a path via two base stations and one control station. For example, there is needed a path like the former mobile station - a first base station - a control station - a second base station - the latter base station. Even though the former mobile station and the latter mobile station simultaneously exist in the first base station zone, the communication therebetween requires a path like the former mobile station - the first base station - the control station - the first base station - the latter mobile station. In other words, the control station serves for any communication among any base stations.

In general, base stations are positioned on tops of mountains in order to give a larger base station zone, which preferably involves no person. In consequence, the base stations require a simple structure immune to a failure or a fault.

In a disaster, however, in the case where there occurs a break in the line between a base station and a control station, even though the base station regularly functions, mobile stations simultaneously laid in the base station zone of the base station fail to communicate with each other.

SUMMARY OF THE INVENTION

It is therefore the object of the present invention to provide a digital mobile communication system which is capable of elevating the reliability of it.

The present invention is relate to a digital mobile communication system in which a base station carries out radio communication with a mobile station laid in the base station zone of the base station and repeats communication between the mobile station and another mobile station laid in one of the base station zone of the base station and the base station zone of one of other base stations via a control station serving as an upper layer, the system comprising:

a line supervision circuit monitoring a line between the base station and the control station to prepare a line switch signal for switching the line upon detection of a break in the line; a signal return circuit returning a signal received from the mobile station to radiate the signal over the base station zone of the base station; and a line switch circuit actuating the signal return circuit in response to the line switch signal.

Another invention is relate to a digital mobile communication system as set forth in claim 1, further comprising a communication circuit radiating the signal received from the mobile station to carry broadcast information to all of the mobile stations over the base station zone of the base station.

Another invention is relate to a digital mobile communication system in which a base station carries out radio communication with a mobile station laid in the base station zone of the base station and repeats communication between the mobile station and another mobile station laid in one of the base station zone of the base station and the base station zone of one of other base stations via a control station serving as an upper layer, the system comprising a signal return circuit returning a signal received from the mobile station to radiate the signal over the base station zone of the base station.

And another invention is relate to, In a mobile communication system including a base station handling a signal for communication between a first mobile station

and a second mobile station both of which are laid in the base station zone of the base station, and a control station exchanging the signal with the base station based upon data for managing the communication, the base station comprising:

a receipt circuit receiving the signal from the first mobile station; a transmission circuit transmitting the signal to the control station; a radiation circuit radiating the signal toward the second mobile station;
and a permission/inhibition circuit inhibiting the transmission circuit from transmitting the signal to the control station and permitting the radiation circuit to radiate the signal toward the second mobile station, according to a request.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing a base station according to the first embodiment;
Fig. 2 is a diagram showing a base station according to the second embodiment;
Fig. 3 is a diagram showing a public business digital mobile communication system;
Fig. 4 is a diagram showing communication in the same base station zone;
Fig. 5 is an diagram showing communication between different base stations; and
Fig. 6 is a diagram showing communication between different control stations.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the preferred embodiments of the digital mobile communication system according to the present invention will be described in detail with reference to the accompanying drawings.

Prior to explaining the preferred embodiments, the public business digital mobile communication system will be briefly discussed for easy understanding of the invention.

In Fig. 3, the control station system 300 mainly incorporates a plurality of base station system 200, and also each base system 200 mainly incorporates a plurality of base station system 100.

The basic system 100 incorporates a base station 20 and a plurality of mobile stations 1 laid in the base zone of the base station 20. The base station 20 controls the plurality of mobile stations 1 to allow their communication. In moving or stopping, the mobile stations 1 carries out their communication. The typical of the mobile stations 1 is a portable telephone and a PHS telephone.

The base station system 200 incorporates a control station 21 and a plurality of base station systems 100. The control station 21 controls each base station 20 to allow it to manage the mobile stations 1 laid in its base zone. Such a construction serves to enlarge the service area in which the business digital mobile communication system is available.

The control station system 300 incorporates a control center 22 and a plurality of base station system 200. The control center 22 controls each controls station 21 to allow it to manage the base stations 20 laid in its control zone.

Subsequently, the operation of the public business digital mobile communication system will be described. First, the signal flow will be described. As shown in Fig. 4, it is assumed that the data D1 including the ID (Identification Data) of the mobile station 3 is transmitted thereto from the mobile station 1. The data D1 is sent to the control station 21 via the base station 20. The control station 21 detects the base station zone in which the mobile station 3 is laid at present, with reference to the position registration information 13 based upon the ID affixed to the data D1. Since the destination mobile station 3 and the origination mobile station 1 exist in the same base station zone, the control station 21 returns to the base station 20 the data D1, which reaches the destination mobile station 3.

As shown in Fig. 5, it is assumed that the data D2 with the ID of the mobile station 4 is transmitted thereto from the mobile station 2. The ID attached to the data D2 is transferred to the control station 21 via the base station 20. The control station 21 detects the base station zone in which the mobile station 4 is now laid, with reference to the position registration information 13 on the basis of the ID attached to the D2. As a result, the control station 21 sends the data D2 to the base station 23, thus reaching the mobile station 4.

In Fig. 6, it is assumed that the data D3 having the ID of the mobile station X is transmitted thereto from the mobile station 5. The mobile station X and the mobile station 5 are controlled by the respective control station stations Z and 21. The data D3 is sent to the control station 21 via the base station 23. The control station 21 detects the control station Z having the base station Y by which the mobile station X is controlled at present, referring to the position registration information 13 based upon the ID attached to the data D3. The control station 21 sends the data D3 to the mobile station X.

Incidentally, the position registration information 13 is indicative of the position of each mobile station. More definitely, the position registration information 13 represents which of the base station zones a mobile station is laid in and which of the control stations the mobile station is laid in. Registration of positions of mobile stations is carried out as following. Registration is performed upon turning on of a mobile station and upon movement of the mobile station from a base station zone to another base station zone, which employs a position registration signal that the mobile station radiates.

Position registration signals are collected into the position management center 30 (see Fig. 3), wherein no

other center or the like exists. The position management center 30 detects the current position of each mobile station based upon the position registration signal received therefrom.

It is assumed that a disaster breaks the line between a base station and a control station. In such a case, the position registration signal radiated by the base station cannot reach the position management center 30 to fail in registering the position of the mobile station. This causes the communication of each mobile station laid in the base station zone of the base station to malfunction.

〈First Embodiment〉

Having briefly discussed the public business digital mobile communication system, the base station according to the first embodiment will be described below. In Fig. 1, The base station 6 for use in the public business digital mobile communication system of the first embodiment incorporates the line supervisor 8, the line switch 9, and the signal returner 10. The line supervisor 8 regularly monitors the line between the base station 6 and the control station 21, and sends the line switch signal S1 to the line switch 9 upon occurrence of a trouble in the line, e.g., a break in the line and an increase in noise. The line switch 9 actuates the signal returner 10 upon receipt of the line switch signal S1 from the line supervisor 8. The signal returner 10 returns a call request signal to the base station zone of the base station 6, when the call request signal is originated by a mobile station laid therein.

As discussed above, essentially, for example, a call request signal for the mobile station 3 originated by a mobile station 6 should reach the control station 21 via the base station 6. Thereby, the control station 21 confirms the position of the mobile station 2 to send the call request signal to the mobile station 3 via the base station 6, whereby the line between the mobile station 6 and the mobile station 3 is established.

However, the explanation below will proceed on assumption that after there occurs a break in the line between the base station 6 and the control station 21, there is originated a call request signal by the mobile station 2 to the mobile station 3. In this case, the line supervisor 8, having already detected the break, gives a line switch signal S1 to the line switch 9, which actuates the signal returner 10. Upon actuation, the signal returner 10 radiates the call request signal toward the base station zone of the base station 6. Accordingly, the line between the mobile station 2 and the mobile station 3 can be established.

Hereinafter, it is assumed that there occurs a call request signal from the mobile station 2 to the mobile station 4 after there occurs a break in the base station 6 and the control station 21, in which the mobile station 2 and the mobile station 4 are controlled by the respective base station 6 and 7. As discussed above, the base station 6 essentially receives the call request signal and sends it to the control station 21, whereby the call request signal should be transmitted to the mobile station 4 from the control station 21 via the base station 7.

The break in the line between the base station 6 and the control station 21 prevents a line between the mobile station 2 and the mobile station 4 from being established. Here, the line supervisor 8 detects the break to send the line switch signal S1 to the line switch 9. Upon receipt of the line switch signal S1, the line switch 9 actuates the signal returner 10. Upon actuation, the signal returner 10 radiates the call request signal toward the base station Zone. However, since the ID involved in the radiated call request signal designates the mobile station 4 laid in another base station zone of the base station 7, the line between the mobile station 2 and the mobile station 4 cannot be established while the break in the line between the base station 6 and the control station 21 remains.

Moreover, it is assumed that after there arises a break in the line between the base station 6 and the control station 21, there is originated a call request signal for the mobile station X laid in the base station Y by the mobile station 2 laid in base station zone of the base station 6. As discussed above, the base station 6 essentially transfers the call request signal from the mobile station 2 to the control station 21, whereby the line call request signal is sent to the mobile station X via the control station Z and the base station Y.

However, the transmission of the call request signal is prevented by the break in the line between the base station 6 and the control station 21. Then, the line supervisor 8, having already detected the break, sends to the line switch signal S1 to the line switch 9, which actuates the signal returner 10. The signal returner 10 radiates the call request signal over the base station zone of the base station 6. The ID contained in the radiated call request signal specifies the mobile station X laid in the base station zone of the base station Y, whereby a call between the mobile station 2 and the mobile station X cannot be established while the break in the line between the base station 6 and the control station 21 remains.

As described foregoing, the digital mobile communication system of the first embodiment gives the following effects. The system enables the communication between a mobile station and another mobile station both laid in the same base station zone even while a break remains in the line between the control station and the base station. Moreover, the system enables the communication between a mobile station and another mobile station that has moved thereinto or started to function therewithin. Therefore, the system can serves for the disaster relief activity as the public business mobile communication system.

(Second Embodiment)

Hereinafter, the second embodiment of the public business digital mobile communication system will be described with reference to Fig. 2. The base station 25 for use in the public business digital mobile communication system according to the second embodiment is provided with the communicator 26, which is the feature thereof while the other components and functions are the same as those of the first embodiment. Accordingly, the difference between the first and second embodiment will be explained in detail below.

The communicator 26 communicates with a mobile station laid in the base station zone of the base station 25. Upon occurrence of a disaster, this function enables instructing the disaster relief activity to a mobile station laid in the base station zone of the base station 25 and broadcasting information on the disaster to all of the mobile stations.

As discussed above, if there arises no break in the line between the base station 25 and the control station 21, for example, the base station 25 transfers a call request signal for the mobile station 3 originated by the mobile station 2 to the control station 21. The call request signal should return to the base station zone of the base station 25 from the control station 21 to be radiated thereover. The ID lying in the radiated call request signal specifies the mobile station 3 laid in the base station zone of the base station 25, allowing the establishment of the connection.

However, it is assumed that there arises a call request signal by the base station 25 to the mobile station 3 after occurrence of a break in the line between the base station 25 and the control station 21. The break does not allows the connection. However, the line supervisor 8, which has already detected the break, sends the line switch signal S1 to the line switch 9. The line switch 9 actuates the signal returner 10. After the actuation of the signal returner 10, the ID involved in the call request signal is radiated over the base station zone of the base station 25. Since the ID designates the mobile station 3 laid in the base station zone of the base station 25, the connection between the base station 25 and the mobile station 3 can be established.

In addition to the effects of the first embodiment, the digital mobile communication system provided with the communicator 26 according to the second embodiment gives the following effects. The system enables the base station to control communication among the mobile stations laid in the base station zone thereof, even though there arises a break in the line between the control station and the base station. In consequence, when there occurs a disaster, this makes it possible to instruct a mobile station on the disaster relief and to carry broadcast information on the disaster to all of the mobile stations.

In another embodiment, this system is available the direct communication among the mobile stations at any time. The direct communication means that the mobile stations make mutual communication each other through the mediation of the base station without the control of the control station.

For this purpose, the base station provides a receipt circuit receiving the signal from one mobile station, a radiation circuit radiating the signal toward another mobile station, and a transmission circuit transmits the signal between the base station and the control station.

In addition, the base station provides a permission/inhibition circuit. At anytime, the request of direct communication is available. Operator makes the request. According to the request, it inhibits the transmission circuit from transmitting the signal to the control station and permits the radiation circuit to radiate the signal toward another mobile station directly.

The system enables the base station anytime to control the direct communication among the mobile stations laid in the base station zone, whether there arises a break in the line between the control station and the base station.

As described above, in the digital mobile communication systems of the first and second embodiments, returning the call request signal depends upon the condition of the line between the base station and the control station. In addition, returning the call request signal independent of it is practicable, which is capable of elevating the reliability of the public business digital mobile communication system.

While the present invention has been disclosed in terms of the preferred embodiment in order to facilitate a better understanding thereof, it should be appreciated that the invention can be embodied in various ways without departing from the principle of the invention. Therefore, the invention should be understood to include all possible embodiments and modification to the shown embodiments which can be embodied without departing from the principle of the invention as set forth in the appended claims.

Claims

1. A digital mobile communication system in which a base station carries out radio communication with a mobile station laid in the base station zone of the base station and repeats communication between the mobile station and another mobile station laid in one of the base station zone of the base station and the base station zone of one of other base stations via a control station serving as an upper layer, the system comprising:

   a line supervision circuit monitoring a line between the base station and the control station to prepare a line switch signal for switching the line upon detection of a break in the line;
   a signal return circuit returning a signal

received from the mobile station to radiate the signal over the base station zone of the base station; and

a line switch circuit actuating the signal return circuit in response to the line switch signal.

2. A digital mobile communication system as set forth in claim 1, further comprising a communication circuit radiating the signal received from the mobile station to carry broadcast information to all of the mobile stations over the base station zone of the base station.

3. A digital mobile communication system in which a base station carries out radio communication with a mobile station laid in the base station zone of the base station and repeats communication between the mobile station and another mobile station laid in one of the base station zone of the base station and the base station zone of one of other base stations via a control station serving as an upper layer, the system comprising a signal return circuit returning a signal received from the mobile station to radiate the signal over the base station zone of the base station.

4. In a mobile communication system including a base station handling a signal for communication between a first mobile station and a second mobile station both of which are laid in the base station zone of the base station, and a control station exchanging the signal with the base station based upon data for managing the communication, the base station comprising:

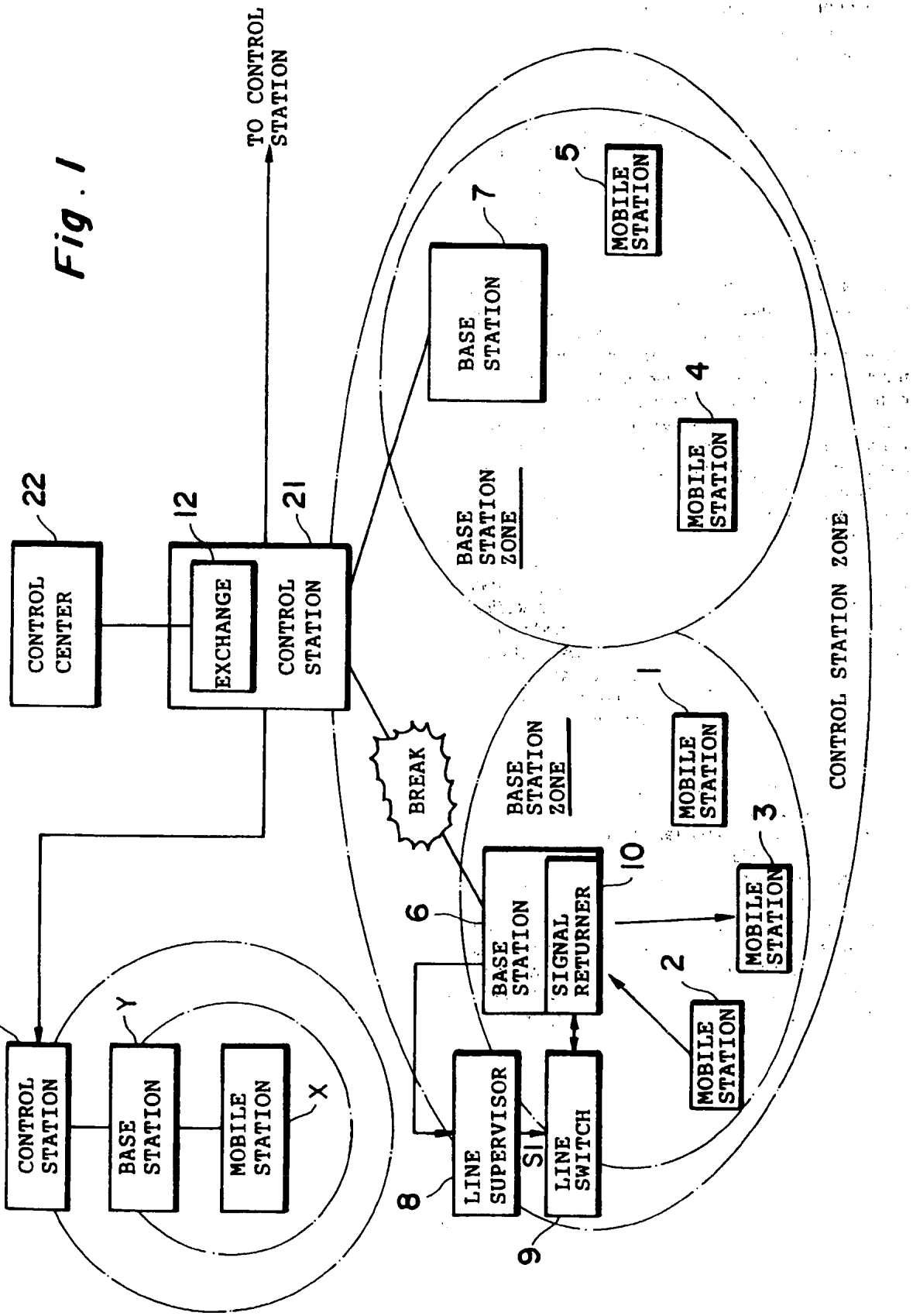
a receipt circuit receiving the signal from the first mobile station;

a transmission circuit transmitting the signal to the control station;

a radiation circuit radiating the signal toward the second mobile station; and

a permission/inhibition circuit inhibiting the transmission circuit from transmitting the signal to the control station and permitting the radiation circuit to radiate the signal toward the second mobile station, according to a request.

Fig. 1


TO CONTROL STATION
CONTROL CENTER
22
12
EXCHANGE
21
CONTROL STATION
BREAK
BASE STATION ZONE
BASE STATION
7
MOBILE STATION
5
MOBILE STATION
4
BASE STATION ZONE
MOBILE STATION
1
BASE STATION
6
SIGNAL RETURNER
10
MOBILE STATION
3
MOBILE STATION
2
CONTROL STATION ZONE
LINE SUPERVISOR
8
LINE SWITCH
9
SI
CONTROL STATION
BASE STATION
MOBILE STATION
Z
Y
X

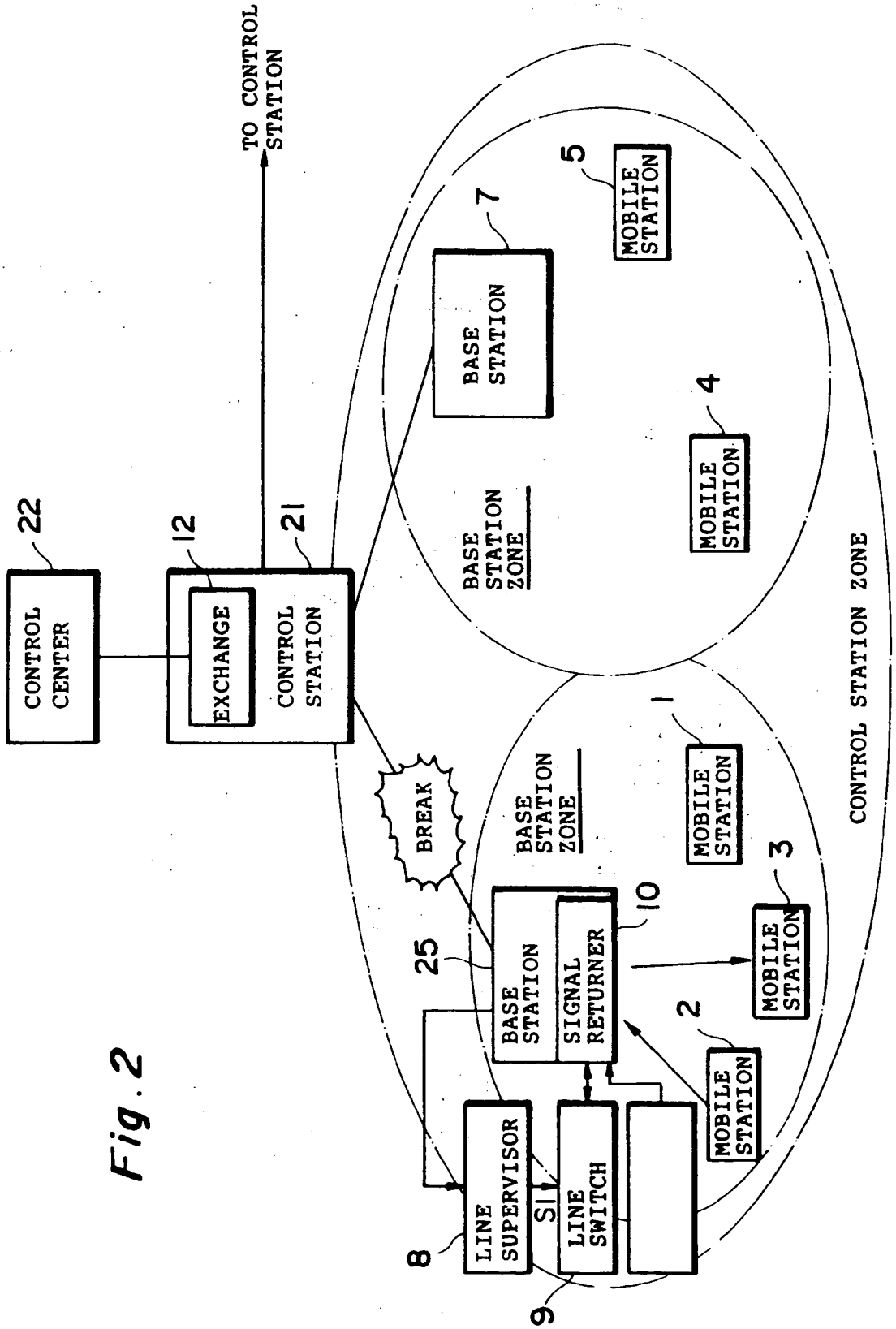
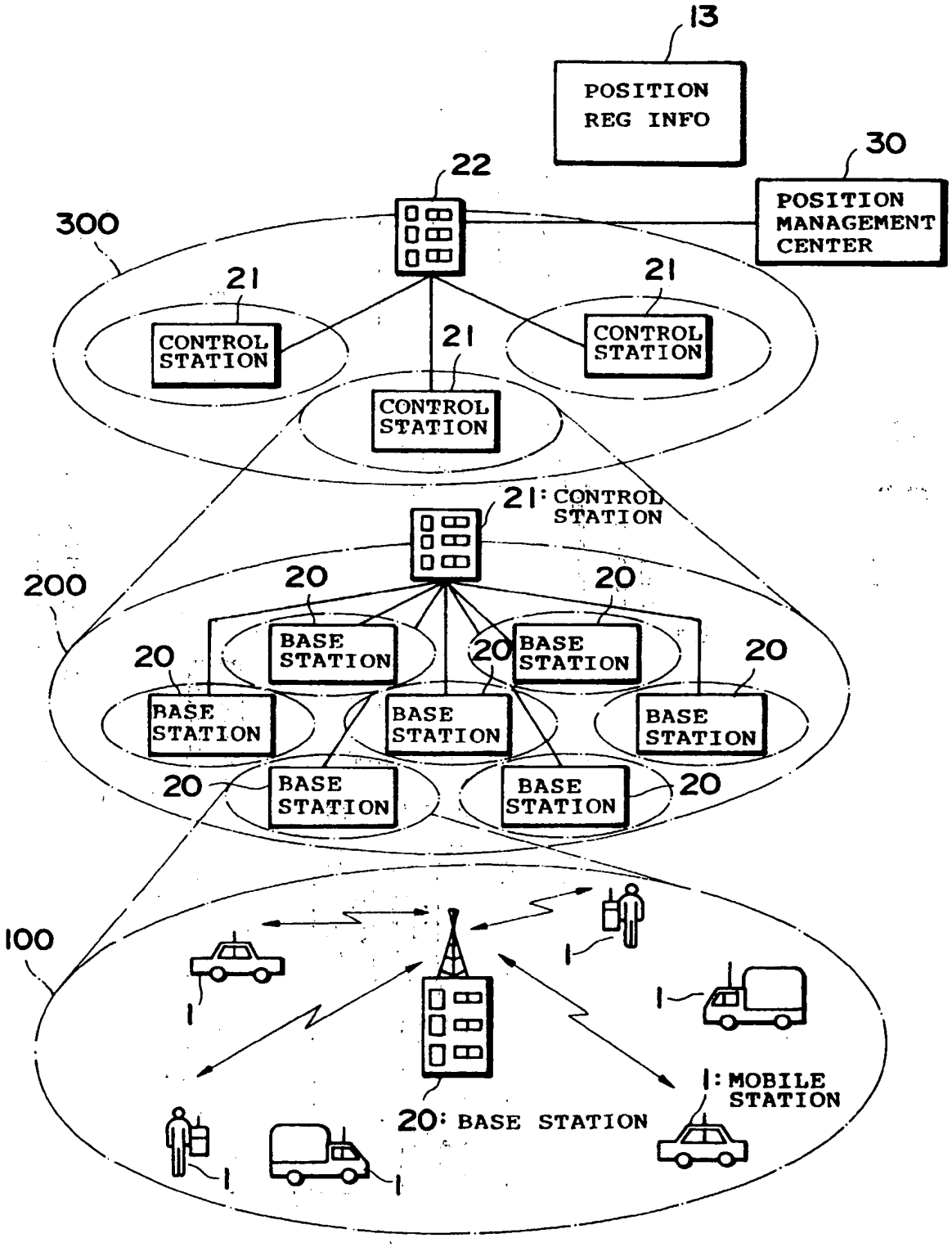

TO CONTROL STATION
CONTROL CENTER
22
EXCHANGE
12
CONTROL STATION
21
BREAK
BASE STATION ZONE
BASE STATION
7
MOBILE STATION
5
MOBILE STATION
4
BASE STATION ZONE
MOBILE STATION
1
MOBILE STATION
3
CONTROL STATION ZONE
25
BASE STATION
SIGNAL RETURNER
10
MOBILE STATION
2
LINE SUPERVISOR
SI
LINE SWITCH
8
9

Fig. 2

Fig. 3

PRIOR ART



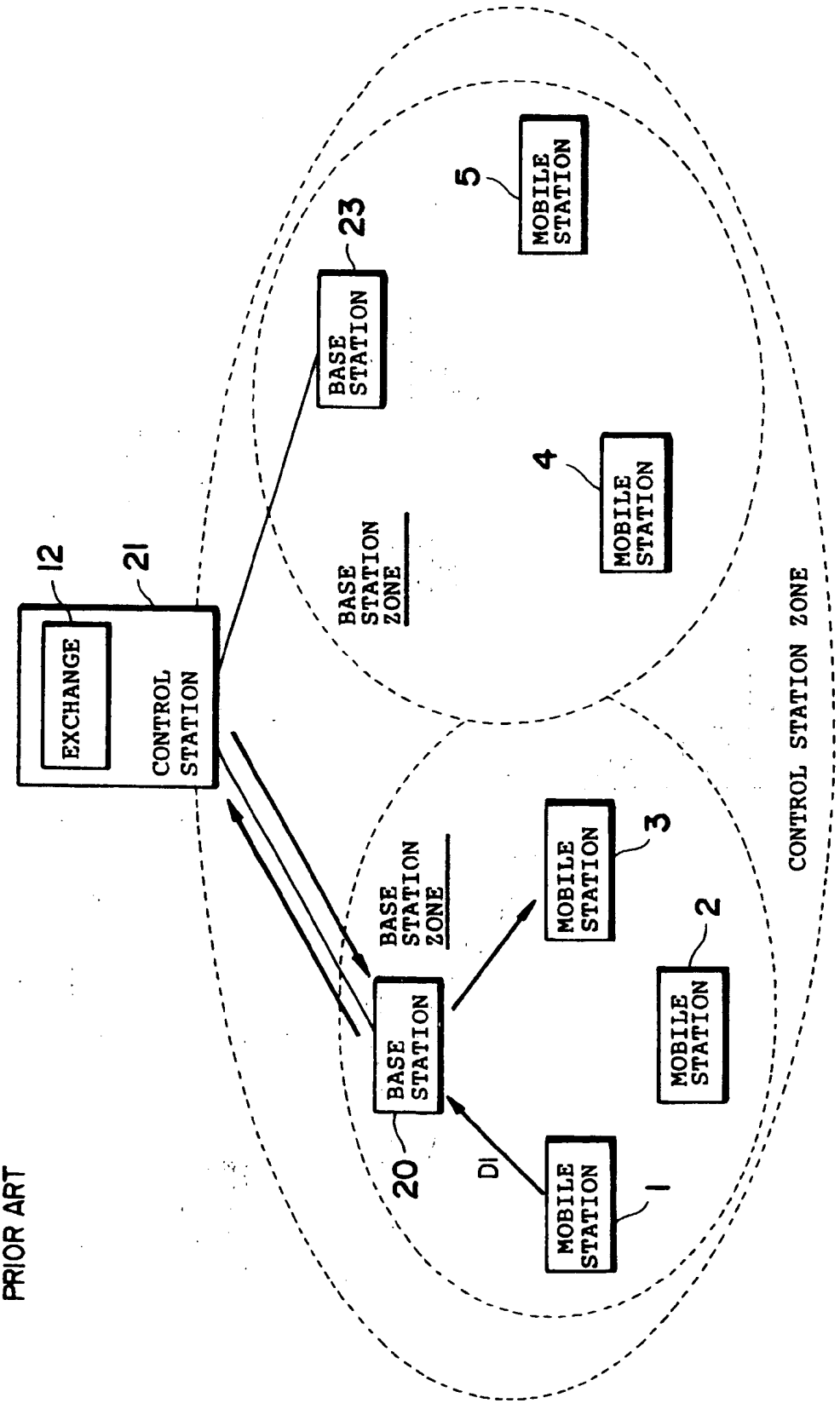


Fig. 4
PRIOR ART

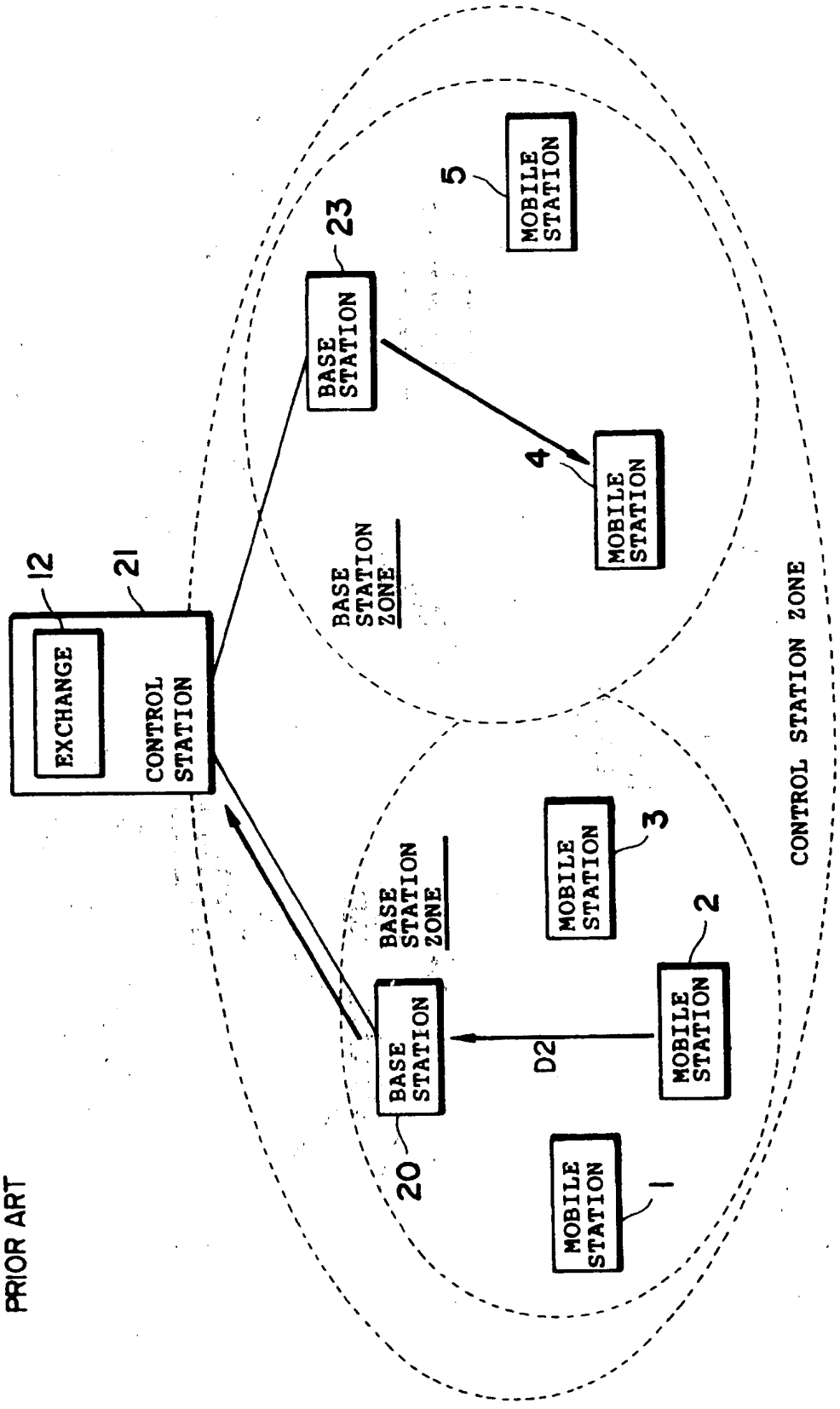
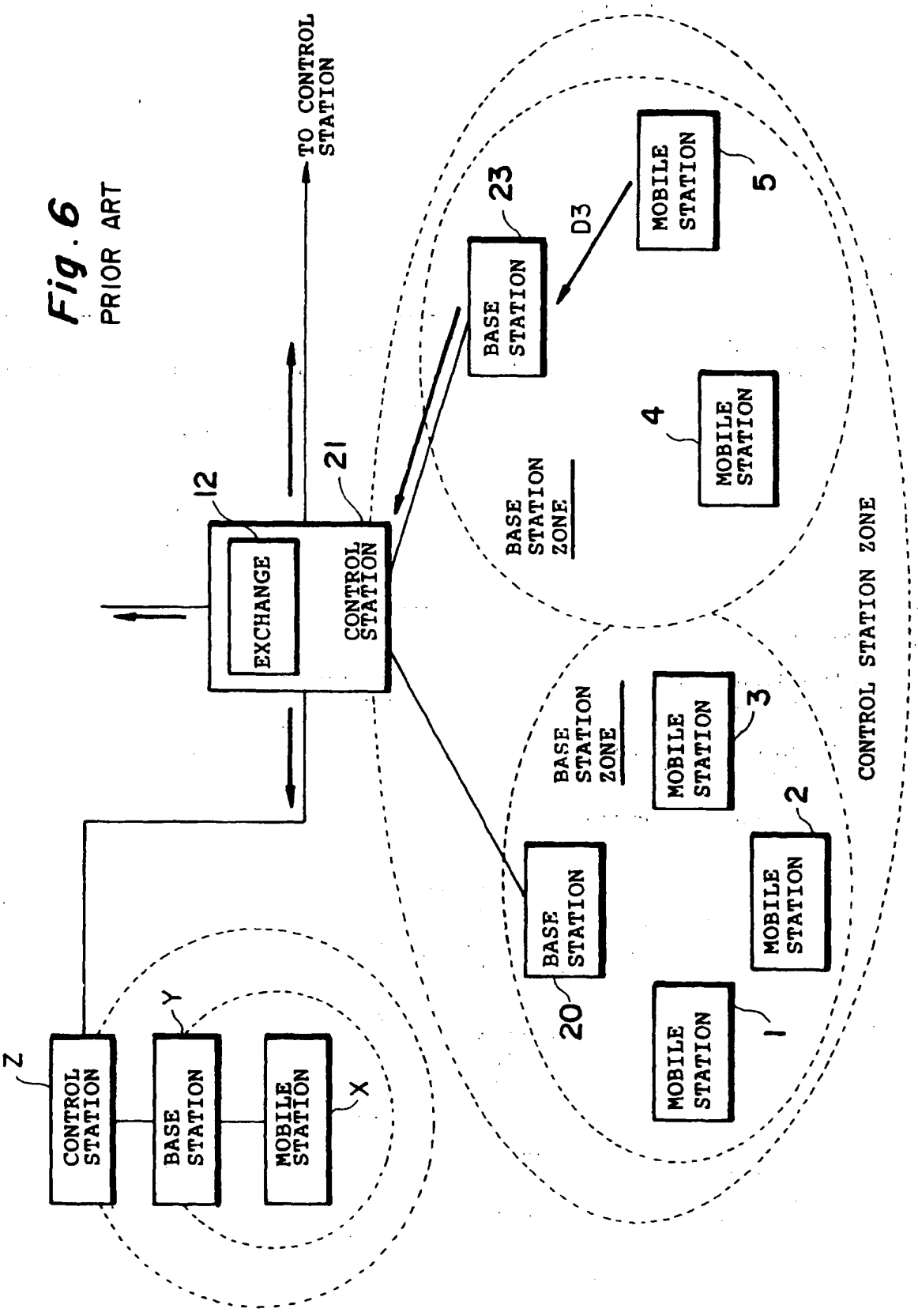


Fig. 5
PRIOR ART

Fig. 6
PRIOR ART



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 893 929 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
02.02.2000 Bulletin 2000/05

(43) Date of publication A2:
27.01.1999 Bulletin 1999/04

(21) Application number: **98106060.1**

(22) Date of filing: **02.04.1998**

(51) Int. Cl.[7]: **H04Q 7/34**, H04Q 7/30, H04Q 7/28

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **23.07.1997 JP 21260197**

(71) Applicant:
Oki Electric Industry Co., Ltd.
Tokyo (JP)

(72) Inventor: **Nakajima, Keiichi**
7-12, Toranomon 1-chome, Minato-ku Tokyo (JP)

(74) Representative:
Grosse, Wolfgang, Dipl.-Ing.
Patentanwälte
Herrmann-Trentepohl
Grosse - Bockhorni & Partner,
Forstenrieder Allee 59
81476 München (DE)

(54) Digital mobile communication system

(57) The base station 6 incorporates the line supervisor 8, the line switch 9, and the signal returner 10. If there is originated a call request signal for the mobile station 3 by the mobile station 2 after occurrence of a break in the line between the base station 6 and the control station 21, the line supervisor 8 notifies the line switch 9 of the line switch signal. In response to the line switch signal, the line switch 9 actuates the signal returner 10. Thereafter, the signal returner 10 returns the call request signal over the base station zone of the base station 6. This enables communication among the mobile stations 2 and 3 laid in the base station zone of the base station 6.

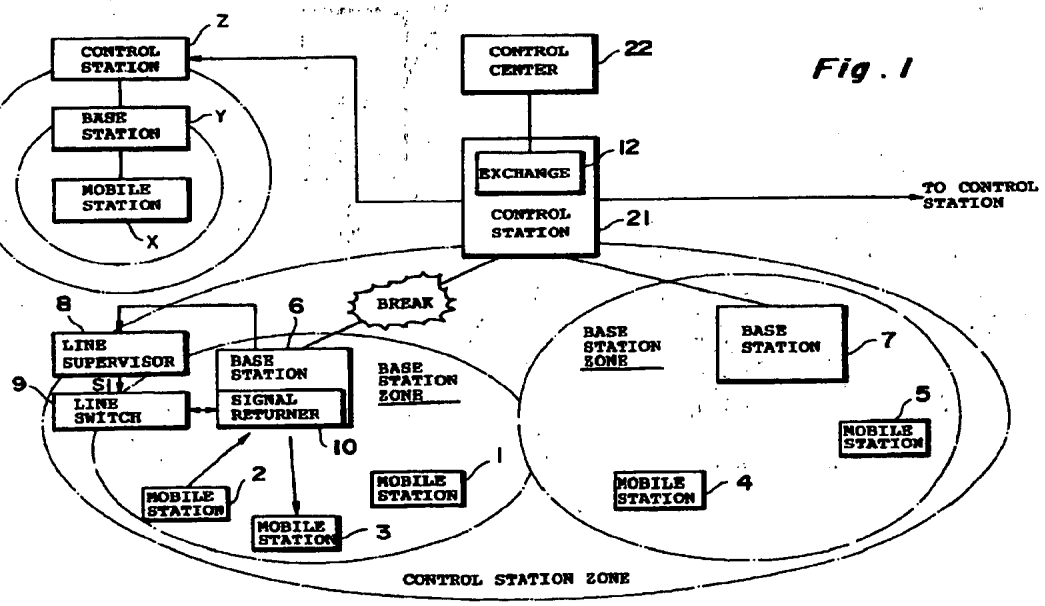


Fig. 1

EP 0 893 929 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 10 6060

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	NORWOOD S ET AL: "DEFAULT WIDE AREA TRUNKING" MOTOROLA TECHNICAL DEVELOPMENTS, SCHAUMBURG, ILLINOIS, US, vol. 29, November 1996 (1996-11), page 71-72 XP000691876	1	H04Q7/34 H04Q7/30 H04Q7/28
A	* page 71, left-hand column, last line - right-hand column, line 4 *	2-4	
Y	US 5 175 866 A (CHILDRESS JEFFREY S ET AL) 29 December 1992 (1992-12-29)	1	
X	* abstract *	3,4	
A	* column 4, line 15 - column 5, line 8 * * column 5, line 50 - column 6, line 38 *	2	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H04Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 December 1999	Behringer, L.V.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 10 6060

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-12-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5175866 A	29-12-1992	US 5274838 A	28-12-1993
		CA 1304132 A	23-06-1992
		DK 50789 A	03-04-1989
		DK 305488 A	15-03-1989
		GB 2206019 A,B	21-12-1988
		GB 2215946 A,B	27-09-1989
		GB 2243273 A,B	23-10-1991
		GB 2247380 A,B	26-02-1992
		HK 80192 A	23-10-1992
		HK 80292 A	23-10-1992
		JP 1004126 A	09-01-1989
		JP 2967573 B	25-10-1999
		JP 2500713 T	08-03-1990
		JP 2790147 B	27-08-1998
		KR 9609454 B	19-07-1996
		WO 8809969 A	15-12-1988

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82